



Saskatchewan
Environment and
Public Safety

Air and Land
Protection Branch

Refuse Disposal Guidelines for Small Communities

January, 1990

**REFUSE DISPOSAL GUIDELINES
FOR SMALL COMMUNITIES**

**Prepared for
Saskatchewan Environment and Public Safety**

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November 1989



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SECTION 1.0
INTRODUCTION

The safe disposal of solid wastes is an increasing concern in Saskatchewan. In 1983, a report prepared for Saskatchewan Environment indicated that the province had more than 1300 refuse disposal sites, over 950 of which were currently active. Many of these sites are open dumps, or what are commonly called "nuisance grounds", which pose potential health, safety and environmental problems to the surrounding residents. Dumps are a food source for rodents and other animals, and are usually infested with flies, all of which can spread disease to both humans and animals. They are a safety hazard to users through exploding cans, sharp and broken objects, and underground fires, and are hazardous to the environment when their contaminants mix with surface runoff or infiltrate the groundwater. The dump can also be a landscape eyesore. Uncontrolled dumping and scavenging can spread the wastes over a large area, uncontrolled burning can pollute the air, and the wind can blow litter for miles.

While these problems are well known, communities of under 5000 persons have often had difficulty financing proper and safe waste disposal operations. Though they require similar types of controlled disposal methods as the larger centres, they lack the economy of scale which enables economical operation. This results in high disposal costs per capita, which is neither practical nor acceptable. To minimize this financial problem, several different methods of waste disposal can be implemented for small communities. These range from small community landfills, where sanitary landfilling practices have been modified to meet the needs of the small user population, to large regional landfills shared by many small communities and serviced by a network of waste transfer stations. These Refuse Disposal Guidelines have been written to help small communities effectively plan and manage their waste disposal requirements in a way that will maximize their health, safety and environmental protection within a budget afforded by their community's resources.

SECTION 2.0
WASTE DISPOSAL OPTIONS



When a community begins seeking new ways to dispose of its solid wastes, several different options may be discussed. Because of society's increasing concern with the wise use and conservation of our resources, recycling or composting programs may be considered. Or, waste incineration may be considered, especially if the public equate land disposal methods with the unsightly and problematic open dump. Economics, however, will be the deciding factor most often among waste disposal alternatives for small communities, and the landfill is presently the most economical disposal method. These four options are discussed below in greater detail.

Recycling

Recycling and re-use of materials is an environmentally sound practice in the waste management process and can reduce the amount of landfill space required by 10 to 15 percent. In Saskatchewan, currently, there exists some potential to recycle metals, such as steel and aluminum, paper and cardboard, tires, plastics, including plastic pesticide containers, and glass. The viability of recycling, however, depends on the community's location, the distance to markets, transportation costs, and the price paid for the materials. In order to be successful, there must be some economic viability to recycling and, as such, small communities must be careful in making recycling commitments.

Composting

Another technology discussed for small communities is composting. In composting the vegetable, paper and organic portions of wastes are treated and processed to become a soil conditioner. While treating all municipal wastes would make this process expensive, it can be undertaken on a select basis for such wastes as garden trimmings, grass clippings and other pure organic wastes. At present, this method has some potential for waste disposal on a limited basis but requires more development work before becoming a reliable alternative for organic wastes. And, any residual wastes from the composting process, such as metal, plastic and other inert materials, must still go to a landfill for final disposal.

Incineration

Many communities consider incineration as an option because of its ability to reduce the bulk of many solid wastes. This is often considered desirable as many residents perceive landfill disposal as being messy, smelly and unsightly. By today's standards, however, incineration that meets the Saskatchewan Clean Air Act requirements is about ten times more expensive than landfilling. While the potential to use solid wastes as an energy source can reduce this cost, recent experience indicates that the sale of energy extracted from waste incineration still leaves incineration costs about five times more than landfilling costs. While there are small incinerators available that are less costly, these units can not meet the Saskatchewan Clean Air Act emissions requirements and, as with composting, the residual ash from incineration must still be disposed of at a landfill.

Landfills

The landfill is the most popular means for disposal of municipal solid wastes because it is economical and can be designed to a size and complexity to suit any community's requirements. In contrast to the open dump, a landfill is carefully planned and operated to ensure both human and environmental health. While a landfill can be designed to meet the needs of only one small community, the development costs required may be high enough that the joint use of another community's disposal site becomes attractive. Or, a group of communities may band together to operate one large landfill site to serve a whole region. Experience with regional landfills in other parts of Canada has indicated that rural residents will transport wastes for disposal up to 16 kilometres from their home, especially if the site is on route to a major centre. Some communities have taken this regional landfill concept further. Residents transport their wastes to one of a series of waste transfer stations where they are regularly collected by large waste trucks and delivered to a landfill. Utilizing the same type of waste containers in several small communities can often justify the joint purchase of equipment to provide service to them all over a weekly period. Several communities in Canada have successfully implemented these systems.

Conclusion

When considering new waste disposal systems for their communities, many groups tend to suggest incineration or other high tech solutions. It is important to remember, however, that there is no waste disposal process known that does not require a landfill to dispose of the non-useable residual. There are, however, many possible solutions for the operation of an environmentally sound and economically feasible landfill site. In light of this, the remaining sections of this guide detail the landfill waste disposal options that are applicable to small communities with populations up to approximately 5000 persons.

SECTION 3.0

LEGISLATIVE AUTHORITY FOR WASTE MANAGEMENT

Historically, refuse disposal for Saskatchewan's small communities has occurred in open dumps which are often a source of aesthetic, environmental and human health problems. In recognition of this, regulation of municipal solid waste disposal began in 1974 under the Public Health Act. At this time a number of communities endeavored to upgrade their waste disposal operations from open dumping to modified landfilling practices. Many municipalities, however, expressed concerns about the expense of maintaining these landfills and, as a result, a voluntary permit system was introduced in 1976. Waste management for many communities, therefore, is presently still at the open dump level.

Responsibility for Saskatchewan's municipal landfills was transferred from the Department of Health to the Department of the Environment in 1984, where it is currently administered by the Waste Management section of the Land Protection Branch. Municipal Refuse Management Regulations were enacted in June, 1986, under the Environmental Management and Protection Act which identified procedures required by the Department for the approval, operation and management of municipal waste disposal grounds. Under these regulations, two methods of waste disposal are permitted; sanitary landfilling, for population centres over 5000, and modified landfilling, for population centres under 5000.

Under these regulations, each urban municipality and each subdivision or group of ten or more dwellings within a rural municipality must be provided with some sort of refuse collection system and a waste disposal ground. Table 3.1 identifies 687 communities and 299 rural municipalities in the province. Associated with these are over 800 active disposal sites. As most of these communities are very small (154 unincorporated; 240 incorporated settlements under 250 people; and 103 villages between 250 and 500 people), the majority of Saskatchewan's refuse disposal grounds are associated with very small communities. A study of land disposal sites by Dillon (1983) concluded that "the population base in southern Saskatchewan is not adequate to support the environmentally sound operation of the existing large number of active municipal land disposal sites." While joint collection and disposal systems among neighboring municipalities are permitted under the Municipal Refuse Management Regulations, few of these systems have been initiated.

TABLE 3.1
Saskatchewan Communities

Cities	12
Towns	144
Villages	325
Resort Villages	38
Organized Hamlets	141
Northern Towns	2
Northern Villages	12
Northern Hamlets	13
Rural Municipalities	299

Source: 1989 Municipal Directory, Saskatchewan Urban Affairs and Saskatchewan Rural Development.

3.1

THE SASKATCHEWAN APPROVAL PROCESS

When a proponent desires to establish a new waste disposal ground, an information package and application forms from Saskatchewan Environment and Public Safety (SEPS) should be obtained. Sample copies of the required applications and permits are included in Appendix 1, and the approval process is summarized as follows.

- | |
|---|
| <p>STEP 1 <i>Make Application for Approval to Establish a Waste Disposal Ground to SEPS. The application must contain:</i></p> <ul style="list-style-type: none">- applicant information- a site description- information regarding adjacent land uses, and- details of the proposed design and operation. |
|---|

Once received, a review of the application and a site investigation will be undertaken by SEPS. Several related agencies may be asked to provide comments on the application and the necessity of undertaking an Environmental Impact Assessment is determined. An EIA, however, is usually only required at larger sites. If the proposed site is not considered suitable for waste disposal, SEPS will provide assistance in selecting another choice. If the site is suitable, additional information on hydrogeological conditions and a determination of means to prevent groundwater pollution will usually be required. These are often the most significant and costly technical problems encountered in siting a landfill.

STEP 2 *A Certificate of Approval to Establish a Waste Disposal Ground is issued by SEPS.*

This certificate is issued following all the site reviews. It is only a permit to establish a waste disposal ground, not a permit to operate one, and it may set certain minimum conditions that must be met in the landfill construction. Such conditions could include bottom liner, access road, or site fencing requirements, among others.

STEP 3 *When construction is completed, proponent makes Application for Permit to Operate a Waste Disposal Ground.*

This application should be made once construction of the waste disposal ground is complete. SEPS will make another site inspection to identify whether any additions or changes to the construction is necessary. If changes are required, a final site inspection will be necessary to verify them.

STEP 4 *A Permit to Operate a Waste Disposal Ground is issued by SEPS.*

Once the permit has been granted, the waste disposal site may be put into operation. The operator must ensure that any general or specific conditions required by SEPS are followed. When the site has reached its capacity, the operator must notify SEPS of the intention to decommission it. The requirements for close-out, monitoring, maintenance and end use will then be made known by the department.

SECTION 4.0

LANDFILL PROBLEMS AND SOLUTIONS

Many of Saskatchewan's waste disposal facilities are currently operating as open dumps. Though easy and inexpensive to operate, they are generally a nuisance and an unfavorable method of waste disposal. Typically, they are unsupervised and uncontrolled with wastes of all types dumped without segregation and no regular compaction or covering of wastes occurring. Site operations that do occur are generally only to grade the access road and keep the working area accessible.

Communities that currently operate open dumps can make significant improvements to their sites by implementing some simple landfill operating techniques. Organizing the remaining disposal space to identify where wastes can be deposited, progressively dumping according to a plan, and periodically compacting and covering the wastes will remove visible problems. It can also reduce air and water pollution and improve aesthetics.

While these improvements are being made, investigations similar to those used to choose a new site should be made at the current dump site. Investigations of soil type and depth, surface water drainage, and the depth to the water table should be determined to examine the suitability of this site for landfilling. If it is not suitable, steps should be taken to find a new site and reclaim the existing one.

Though these simple steps may result in improvements, the site operations must maintain this new control or it will revert to former open dumping practices.

One of the best waste disposal alternatives for small communities is the modified landfill. In this method, landfill space is well organized and developed according to a plan which includes the regular compaction and covering of the waste. Efficient operation requires careful site selection, the identification of disposal areas, provision for stockpiling topsoil and cover materials, and the planning and construction of access roads, drainage facilities and fencing. The wastes are deposited in a planned sequence, using only small areas of the site at one time. By using soil material from one part of the disposal area to reclaim another, finished disposal areas are redeveloped and landscaped as new ones are put into operation.

The modified landfill will provide a relatively inexpensive disposal method and a good level of service for small communities if it is well planned, designed, operated and maintained. It is an appropriate disposal method where dedicated equipment and continuous supervision may not be economically feasible, and where the daily or weekly accumulation of waste is small.

As numerous environmental and operational problems can be associated with landfill facilities, however, a variety of means have been devised for their solution. While all the following concerns may not become significant at smaller sites, they can become so and should be addressed in the larger sites of communities up to 5000 persons. A review of the problems and solutions normally found at landfill disposal facilities follows.

Groundwater Contamination

Local soil and geologic conditions can make siting a landfill difficult in some areas if environmental concerns are to be minimized. At present, many of Saskatchewan's disposal sites are located where water contaminated through contact with the wastes can easily enter the ground or surface water systems. To minimize groundwater concerns, solid waste disposal planning should consider the following:

- o Ideally, if surface water can not be controlled and geologic conditions are not suitable, the site should be closed.
- o If the existing site has less than ideal geologic conditions, a program to control and remove the water contacting the wastes can be implemented. Such a program could include constructing earth berms and drainage ditches, and establishing a pumping program. When water can be kept from contacting the wastes, groundwater contamination can be kept to a minimum.
- o If geologic conditions are a concern, a groundwater monitoring program can be undertaken to assess the extent of any problems and to enable decisions to be made regarding their solution.

- o A good rule to remember is that if contact between wastes and water is reduced, so is the chance of liquid contaminants existing in and moving from the site.

Surface Water Contamination

Surface water contamination may also occur when water contacts the waste and flows off from the site. While it is impossible to stop all contact between water and wastes, proper design and operation can reduce this contact to acceptable levels.

Several solutions to the problem include:

- o Constructing berms and channels to divert surface water away from the wastes.
- o Removing any ponded water in the waste disposal areas.
- o Grading the trenches and disposal areas to allow drainage from the current working area.
- o Providing suitable cover and grading completed areas to allow water to run off.

Litter

Litter, though not a serious environmental problem, has much to do with the public's perception of land disposal sites. It is an extremely visible aspect of the landfill on the surrounding area and can become a major problem for farmers when it catches on agricultural implements. Several methods can be implemented to control the problem.

- o Fence the entire landfill area with litter catching fences.
- o Use windbreaks or snowfencing to reduce the wind hitting the wastes.
- o Align disposal trenches or berms perpendicular to the prevailing wind.
- o Clean litter fences regularly.
- o Minimize the size of the working face.
- o Encourage wastes to be covered while in transit or for users to bag their wastes.
- o Frequently cover the wastes.

Health Standards

Health problems normally occur when there is a lack of adequate covering over the wastes. Wastes that remain uncovered for extended periods enable flies to breed and provides food for rodents and animals. Health concerns also arise when water ponds in or near the wastes or through the improper disposal of dead animals, hospital wastes, faecal material or any other material that should either not be accepted or should have special disposal procedures applied.

- o Most health problems can be eliminated when the wastes are covered often and when control measures are implemented to reduce the contact between wastes and water.
- o Animal carcasses should be disposed of in a separate pit and covered with a substantial amount of soil. Though lime is often used to cover animal carcasses, this treatment is considered to do little good, and 600 - 1000mm of soil is preferable.
- o Hospital wastes from small facilities can be safely landfilled if they are disinfected with bleach and covered immediately. Infectious hospital wastes should not be placed in landfills.
- o Faecal wastes should not be mixed with regular wastes.

Waste Burning Emissions

Foul emissions such as smoke and debris are often associated with open pit waste burning. Where it becomes desirable to burn selected municipal waste, permission must be obtained from Saskatchewan Environment and Public Safety and several common sense actions should be taken.

- o Site the burn pits downwind from the community.
- o Control and supervise the burns.
- o Control and sort the wastes placed in the burn pits.
- o Burn the wastes only under proper weather conditions.
- o Have access to fire control equipment during burns.

A better level of operation at these burn pits can be achieved through the use of air curtain incinerators. These incinerators are basically pit burners that place a curtain of air over the pit and force the emissions back into it for a higher level of combustion. While this is considered an operational improvement, it also introduces new control features and applications under the Clean Air Act.

Scavengers

Scavenging, especially at unsupervised sites, is a frequent occurrence. Although it is a form of recycling and can reduce the required landfill space somewhat, there are both health concerns and messes related to scavenging. These problems are very hard to eliminate, however, without controlled access and supervision at the site.

- o A partial solution is to clearly define the areas allocated for the placement of recyclable wastes. Digging through all the wastes for the recyclable goods is thus controlled.
- o A second stage to this approach is to limit the removal of materials from these areas either by enforcement or by allowing private service groups to access the materials.

Supervision

Supervision can make a significant difference in the level of operation at a landfill site. The pros and cons of such a decision must be considered by a community and, if it is felt beneficial, a change of procedures may be required to enable the site to be effectively and economically run. Some potential means of enabling a supervised operation are:

- o Reducing the hours of operation to a level where supervision can be provided within the community's waste disposal budget.
- o Controlling site access by using a locking gate and requiring users to obtain a key through the Town Office.

- o Establishing local by-laws and enforcing simple rules and regulations regarding proper site usage.
- o Establishing a warden system where nearby residents monitor and report site operations on a part-time basis.

The significant benefits to site operation that occur with supervision can offset the reduced hours of operation or level of accessibility.

Winter Operations

Winter operations create special problems for landfill operators especially related to the placement of cover over the wastes and the introduction of snow and snow-melt into the landfill operations. The operation of a modified landfill allows wastes to be placed all winter without the addition of periodic cover though a litter problem may develop when snow is the only agent to stop blowing wastes. The placement of even small amounts of cover during this period can greatly reduce littering and reduce the problem of snow-melt in the spring.

- o Frost conditions make it difficult to excavate and place cover materials over the wastes. Stockpiling cover soil in loose piles can make it much easier to excavate when frozen. A backhoe or loader bucket is ideal for this.
- o The use of a granular material like sand or gravel that can be more easily stored, excavated and moved in winter will still provide a much better cover than snow.
- o In the spring, the exposure of five or six months of hidden litter poses a housekeeping problem. It should be picked up as soon as possible.
- o The large amounts of uncovered wastes also need remedial action in the spring. Ponded water should be removed and cover provide for these wastes.
- o Good site planning in the fall should locate cover material close to the working area and provide a good drainage system with adequate grades to ensure that snow-melt runs away from the site.

- o Another alternative is to plan new cell construction for the spring and use the excavations to cover the previous winter's waste.
- o Working quickly when spring comes will minimize the effects of winter's operation.

Public Involvement

Public involvement is becoming a very important factor in the siting of almost any development, especially those that are perceived to have negative environmental, health or aesthetic implications. Landfill siting attempts in other parts of North America have received strong opposition from groups who desire well run waste disposal facilities, but "Not In My Back Yard" (NIMBY). Many of their perceptions, however, may have been formed from sites which were poorly run. Public information programs may be necessary to ensure residents that a new landfill site or transfer station will be acceptable. Without public education and involvement, the most environmentally sound site may be rejected.

SECTION 5.0
WASTE GENERATION RATES
AND DISPOSAL VOLUMES

Many factors influence the area required for a waste disposal site. These include the present and future population expected to use the site, the amount of waste they generate, the degree of compaction these wastes receive, the depth to which wastes can be placed, and the planned life of the site. The following sections provide a starting point for small communities to estimate their space requirements for waste disposal.

WASTE GENERATION ESTIMATES

Waste disposal data from small communities in various parts of Canada is diverse but generally indicates a range between 1-2 kg (2.2-4.4 lbs) per person per day. This value usually includes a mix of residential, commercial, and institutional wastes such as paper, wood, metal, glass, food wastes, yard trimmings, plastics, rubber, oil, and other type materials, but excludes many of the bulky wastes, such as construction debris, abandoned automobiles or discarded furniture.

An estimate of Saskatchewan's waste generation rates can perhaps be best obtained from small Regional Disposal Systems in Alberta where excellent records have been kept. Weigh scale data from four facilities used by communities of 5000 persons or less, illustrated an average waste generation rate of 1.50 kg/capita/day, or 0.55 tonnes/capita/year. This figure may provide a good starting point to estimate waste generation rates for Saskatchewan's small communities. Table 5.1 lists the daily and yearly waste generated for different sized communities based on these waste generation estimates. If actual waste generation is found to be significantly different, the landfill operation can be adjusted after its first year of use.

TABLE 5.1
Estimated Waste Generation Rates for
Saskatchewan Small Communities

POPULATION	WASTE GENERATION	
	PER DAY (kg)	PER YEAR (tonnes)
1000	1500	550
2000	3000	1100
3000	4500	1650
4000	6000	2200
5000	7500	2750

Waste compaction is a significant variable affecting the size required for a landfill site. The amount of compaction the wastes receive depends on the type of equipment used, how the wastes are handled, and the number of passes the machine makes over them. Figure 5.1 indicates how compaction density increases as the number of equipment passes made over them increases. While density increases with every pass, the most significant compaction benefits occur after four or five passes. Similarly, Figure 5.2 shows how the density achievable varies with the thickness of the layers the wastes are spread into. Potential compaction density declines rapidly as waste layers become thicker. To achieve good compaction, therefore, wastes should be spread into layers of about 0.6 m (2 ft) thickness, and compacted with four or five passes of the machine.

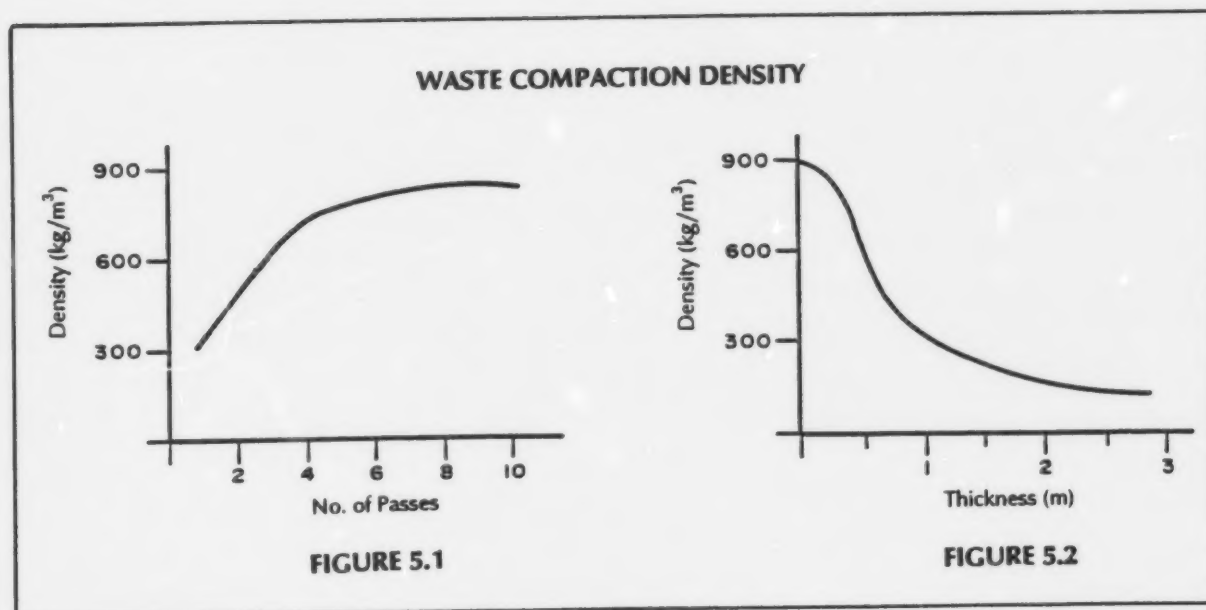


Table 5.2 indicates how compaction density varies with the type of landfill equipment used. When no equipment is used and wastes are merely dumped into a trench, their density varies from about 60-120 kg/m³. While steel-wheeled compactors can obtain the best waste compaction of all, they are specialized pieces of machinery that are normally found only at large landfill sites. Most landfills for small communities will use tracked machines for waste handling from which a variety of densities are attainable depending on how the wastes are handled.

TABLE 5.2
Compaction Effort

COMPACTION	EQUIPMENT	METHOD	DENSITY
Poor	None	Wastes dumped into trench.	60 - 120 kg/m ³ 100 - 200 lb/yd ³
Minimal	Tracked Machine	Wastes dumped into trench. Equipment compacts surface of wastes.	120 - 300 kg/m ³ 200 - 500 lb/yd ³
Moderate	Tracked Machine	Wastes spread in layers. Each Layer is compacted with one pass of the machine.	300 - 475 kg/m ³ 500 - 800 lb/yd ³
Good	Tracked Machine	Wastes spread in thin layers. Each layer compacted with three to five passes of the machine.	475 - 600 kg/m ³ 800 - 1000 lb/yd ³
Excellent	Steel-wheeled	Wastes spread in thin layers. Each layer compacted with the machine with up to five passes.	over 600 kg/m ³ over 1000 lb/yd ³

Source: Alberta Environment.

5.3

VOLUME REQUIREMENTS

The volume required to dispose of wastes depends on the amount of waste generated and the amount of compaction they receive. Generally, waste in small communities is not overly compacted and the earth cover is placed on a quarterly or semi-annual basis. The following examples illustrate how waste disposal volume requirements can be calculated.

Waste receiving minimal compaction has a density around 210 kg/m^3 (350 lbs/yd^3). The per capita volume required for waste disposal, therefore, can be calculated as:

$$\frac{550 \text{ kg/capita/year}}{210 \text{ kg/m}^3} = 2.6 \text{ m}^3/\text{capita/year}$$

If a typical waste cell in a modified landfill which receives periodic cover is considered to consist of seven parts waste to one part cover, the volume required to contain the waste plus the cover would be:

$$\begin{array}{rcl} 2.6 \text{ m}^3/\text{capita/year} & + & 1/8 (2.6 \text{ m}^3) \\ \text{Waste} & + & \text{Cover} \\ \hline & = & 3.0 \text{ m}^3/\text{capita/year} \\ & & = \text{Total cell volume} \end{array}$$

If a moderate to good compaction effort could be obtained, however, the required yearly per capita volume of wastes could be substantially reduced. At a compaction density of 475 kg/m^3 , the per capita volume for waste disposal would be calculated as:

$$\frac{550 \text{ kg/capita/year}}{475 \text{ kg/m}^3} = 1.2 \text{ m}^3/\text{capita/year}$$

Again, if the typical waste cell in a modified landfill was seven parts waste to one part cover, the volume required to contain these wastes and cover would be $1.4 \text{ m}^3/\text{capita/year}$. Compaction effort, therefore, is a major variable in the required yearly disposal volume.

As a planning tool, a range between 1.4 to $3.0 \text{ m}^3/\text{capita/year}$ can be used to estimate the annual volume required for waste disposal at small communities under varying levels of compaction. Figure 5.3 graphically depicts these annual volume requirements. These estimates can be modified once the landfill is in operation and actual conditions are known.

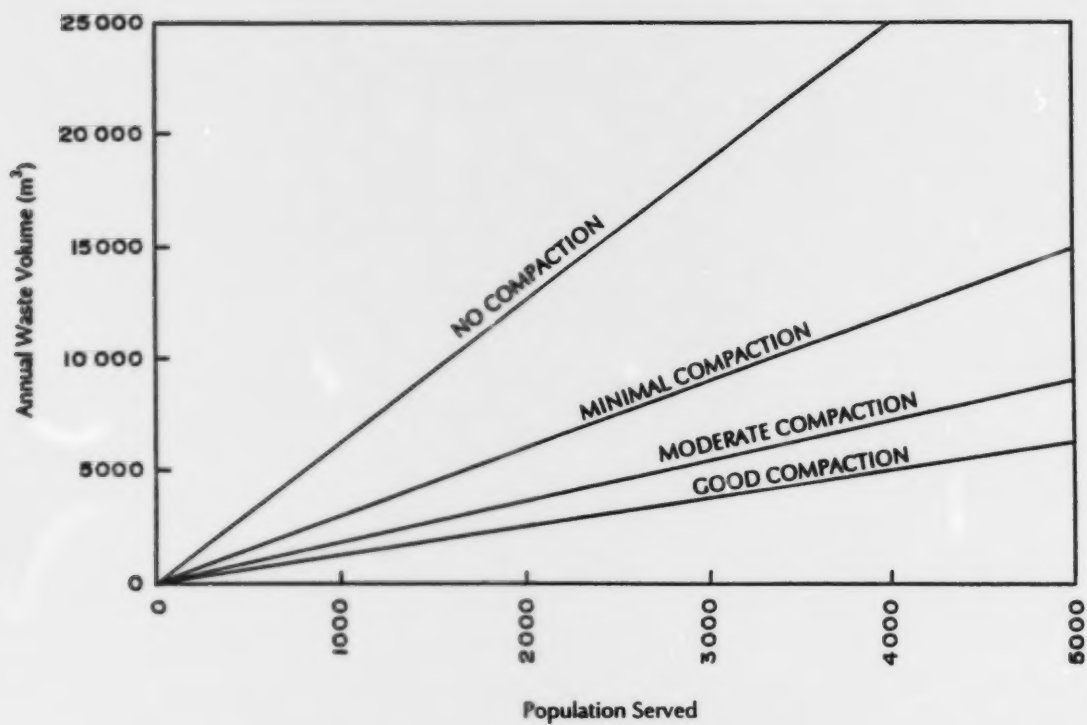


FIGURE 5.3
VOLUME REQUIREMENTS FOR WASTES
UNDER VARYING LEVELS OF COMPACTION

SECTION 6.0

SITE SELECTION AND INVESTIGATION

A recent study has identified three categories of land disposal sites in Saskatchewan based on their potential to impact on health and the environment (Dillon, 1983). The majority of active sites were considered to have a moderate potential to impact, due largely to either their siting, or their operating practices. Though few sites had a high potential to impact, the number could have been substantially greater if not for our small number of large population centres, the predominance of clay soils, a low moisture surplus, and our small industrial base. Better siting decisions and operational practices could reduce many of these sites potential impacts to low. Selecting the proper site, therefore, is an important first step in a solid waste disposal system if many of the problems associated with dumps are to be eliminated.

A well-sited landfill should:

- o Have proper soils on site for construction and covering of waste disposal cells.
- o Safeguard against potential surface or groundwater pollution.
- o Not be a nuisance or danger to public health.
- o Be aesthetically pleasing to area residents regarding litter, odours and smoke.
- o Be easily accessible in any weather.
- o Not detrimentally impact environmentally sensitive areas.

In addition, several characteristics are desirable, though not necessary, when siting a landfill.

- o Avoid areas which require special operating procedures and increased costs.
- o Conform to proper land use planning.
- o Be down wind from population centres.
- o Maintain economical travel distances from the community.
- o Be large enough to adequately accommodate waste disposal for many years.

Table 6.1 and the following sections outline many of the features that should be considered when selecting a waste disposal site.

TABLE 6.1
Evaluating a Proposed Site

ITEM	FAVOURABLE	QUESTIONABLE	UNFAVOURABLE
Soil Type	Clay, silt, tills more than 10 m thick	Fissured till less than 10 m thick	Gravels, sand, rock
Groundwater	No shallow groundwater	Groundwater present but at least 3 m below deposited wastes	Shallow groundwater less than 3 m below deposited wastes
Surface Water	Dry flat land, 0-6% slopes, well drained	Ravines, slough areas	Lakes, streams, floodplains
Distance Requirements - Cemetery - Roads or Railways - Residence - Hospital - Food Outlet	Over 100 m Over 100 m Over 500 m Over 500 m Over 500 m		Less than 100 m Less than 100 m Less than 500 m Less than 500 m Less than 500 m
Size	20 years usage or greater	10 to 20 years usage	Less than 10 years usage

Modified from Alberta Environment.

6.1 SURFACE AND SUBSURFACE CONDITIONS

The surface and subsurface features of an area are important factors in selecting a proper waste disposal site. Knowledge of the area's topography, the type and extent of soils, the type and depth of bedrock, and the depth and movement of groundwater is necessary to determine the ease and potential for excavation of suitable disposal areas and to predict the possibility of off-site contamination.

Topography

Surface drainage and many of the site's design features are influenced by the area's topography. By making use of natural barriers, major landforms, depressions and drainage patterns, the earthwork required for site preparation, operation and maintenance can be minimized. The terrain should be reasonably flat and well drained, with slopes ranging from 0 - 6 percent. Areas where water flows, such as

ravines, streams and floodplains, or where water stands, such as lakes, sloughs, wetlands or bogs, should be avoided.

Soils

The soil found on the site will ideally provide:

- o A suitable cover material for the wastes.
- o A stable support for construction activities.
- o Ease of access to and around the site.
- o A barrier to the off-site migration of gas and leachate.

Ideally, waste disposal sites should be located in fine-textured soils such as silts, clays or tills which will restrict gas and leachate movement. To ensure economical waste disposal, the use of on-site soil materials should be maximized. If proper soils are not available on-site, a suitable supply should be sought out and imported for landfill development though this will add to landfill costs. Areas with large deposits of rocks and boulders may become difficult to excavate and operate in.

To ensure control over the downward migration of pollutants, 10 m or more of a relatively impermeable soil is considered ideal. Sites with a lesser thickness may be suitable though special design features, such as the construction of a soil liner, may have to be incorporated. A landfill constructed over a permeable formation such as gravel, sand or fractured bedrock is unsuitable and can pose a significant threat to groundwater quality by the vertical and horizontal movement of contaminants from the site.

Proper soils are also required to periodically cover the wastes. Cover material can be any type of soil or other suitable material that compacts well, does not crack excessively when dry and is relatively free of organic materials and large items. It should act as a barrier to the infiltration of precipitation and snow melt. After the wastes have been compacted, they are covered with soil to form an enclosed cell. This interim soil covering can range in thickness from 150 to 250 mm, upon which additional wastes can be placed.

When a landfill is completed, a final soil covering of 500 to 800 mm is required over the whole area. Of this, 150 mm should be a reasonable topsoil in order to reclaim the area with vegetative growth.

Groundwater

At the sites for larger communities, a hydrogeological study should be undertaken to determine the site suitability in relation to the:

- o Water Infiltration Rate
- o Groundwater Flow
- o Hydraulic Gradient
- o Groundwater Chemistry, and
- o Affects on Existing Adjacent Wells

For smaller sites, the extent of the above groundwater investigations could be reduced somewhat based on their size and any specific site conditions, such as proximity to water supply wells.

Ideally, the water table should be at least 2 to 3 metres below the lowest portion of the deposited wastes. A lesser distance may be acceptable, depending on the nature of the soil and the type and extent of groundwater use in the area. Prior to reducing this standard, however, special considerations should be given to the long term affects of such a decision.

6.2

SITE LOCATION

A site's accessibility and its proximity to other land uses must be considered when siting a waste disposal ground. The site must be close enough to the population it serves so that waste haul distances do not force users to deposit their wastes elsewhere. In addition, it must be accessible to vehicle traffic throughout the year. Access roads subject to flooding or snow drifting are a nuisance and may cause suspended operations or add substantially to operating costs. As construction of all-weather access roads is expensive, it is best to utilize existing roads and to extend them as little as possible.

When applying to SEPS for approval to establish a waste disposal ground, the locations of various features relative to the site must be shown on a sketch plan (see Appendix 1). These include:

- o Roads, railways, or cemeteries within 100 m of the site.
- o Residences, hotels, motels, eating establishments, institutional facilities, or utility transmission lines within 500 m of the site.
- o Waterbodies, irrigation works, wells, historic, recreational or archaeological sites, designated wildlife habitat, and ecological reserves within 1000 m of the site, and
- o Airports within 8 km of the site.

6.3

INFORMATION GATHERING

Several sources of information can be analyzed when undertaking the initial site selection. Topographic maps, soil maps, aerial photographs and local well records can be used to develop a reasonable knowledge of the soil and subsurface conditions. The use of large scale National Topographic Series (NTS) maps is useful for reviewing such parameters as surface drainage, slopes, and the location of various physical and man-made features. Soils maps provide a variety of surface information including soil texture, the landform types associated with the area, and the percentage slope found within it. Aerial photographs are useful to determine precise land uses in the area and a 3-dimensional picture of the site's topography, while local well records provide an indication of the depth and types of soils, and the location of the groundwater table. In addition, determining the predominant wind direction can help place the disposal site where litter, odours and smoke are less of a problem for community residents.

SECTION 7.0
DESIGN CONSIDERATIONS

Designing and constructing a safe and efficient waste disposal facility requires similar steps to other types of municipal activities. Detailed planning must take place for site clearing, earthwork, road construction, drainage control and access patterns, as well as providing for litter control, the phased construction of cells, final grading and landscaping.

7.1

THE DEVELOPMENT PLAN

For disposal sites serving populations under 500 persons, the development plan can be very simple and reflect simply that the community has undertaken consideration of each design element before constructing the site. For sites serving populations over 500 persons, the development plan should reflect a higher level of sophistication and include evidence of this through a documented plan.

Each element of a landfill's design is important and should be undertaken by a qualified person. In the preparation of a plan, consideration of the site's physical aspects will include topography, surface drainage, soil conditions and groundwater. This plan then becomes the operational guide throughout the life of the disposal facility. It includes information on the disposal method to be employed, the size, depth and locations of the excavations, location of roads and storage compounds, the timing of various development phases, and any of the environmental protection measures to be employed, among others. The level of sophistication ideally depends on the size of population served.

The following should be included in the preparation of a development plan:

1. A topographic base map indicating the initial landform and drainage patterns, as well as any initial site improvements. This map could be a standard National Topographic Series (NTS) map with contours and including information such as:
 - o the proposed site boundary
 - o access to the site
 - o existing services

- o zoning and surrounding land uses
 - o surface drainage trends
 - o the locations of all residences, buildings, utility lines, oil, gas and water wells, and any other land uses adjacent to site boundaries.
2. Location plans should be developed to illustrate the waste fill areas, the cover excavation areas, and the locations of newly constructed temporary roads and on-site drainage facilities.
 3. Drawings to show cell locations, roads, storage and burn pit areas may be useful in the construction and operation of the site.
 4. A final plan to illustrate the proposed elevations, minimum slopes, and the final land use planned for the site would be an advantage.

These plans and drawings should be somewhat flexible and should be easily understood by anyone involved with the waste disposal site. If not, they will have little chance of being implemented. The following are some general guidelines that may be useful in designing a waste disposal site.

- o Site plans should show the development in phases, so that only the necessary space required for waste disposal is developed at any one time. Site drainage should be planned to reduce rainwater collection in the open trenches.
- o The best site designs require a minimum of earth moving and only enough material excavated to provide adequate cover for current operations. When practical, the site should be laid out so that newly excavated earth is immediately used as a cover. When stockpiling is necessary, it should be placed nearby and where it can be left undisturbed until required. Topsoil should be stripped from the excavated area and stored in a separate location.
- o In a well planned site, the end use cover and re-vegetation can begin while other landfill areas are still to be developed. As each phase is completed it should be covered and landscaped to its intermediate or end use.

- o At larger sites, establishing some sort of survey control within the site enables the progress of the filling activity and the settlement of the wastes to be monitored.

7.2

LANDFILL METHODS

Disposal planning should take into account topography, hydrogeological conditions, the amount of available cover, and the amount and type of waste to be disposed. There are two basic disposal operational methods that can be considered; the Trench Method and the Area Method. Most disposal sites will use one or a combination of these two methods.

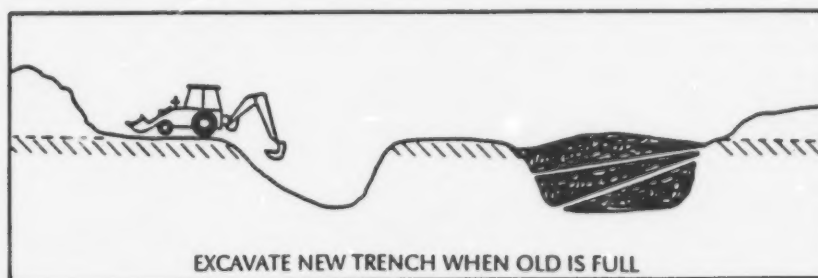
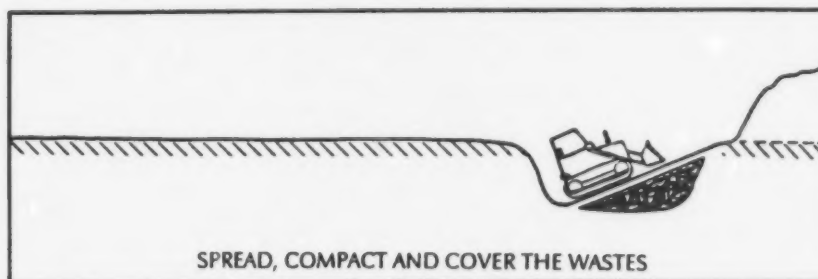
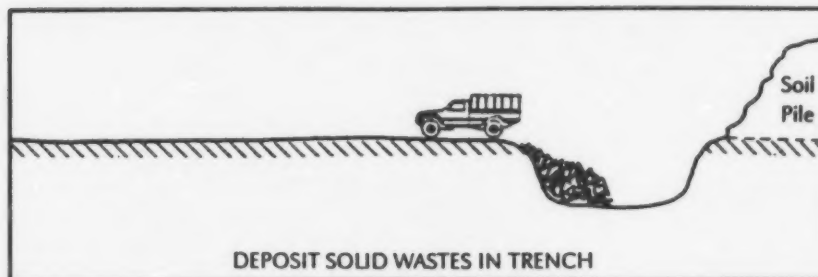
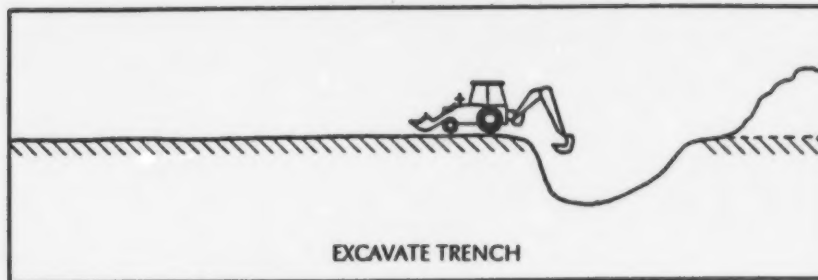
Trench Method

The Trench Method is often used when the water table is deep and sufficient soil exists above the bedrock. It is best on flat to gentling rolling land. In this method, a trench is excavated to contain the wastes and the excavated soil is stockpiled nearby to be used as a cover (Figure 7.1). Wastes within the trench are periodically spread, compacted and covered with a thin layer of soil. When completed, a new trench is excavated and the old one is graded and landscaped using material from the new trench construction.

Some general guidelines in the operation of the Trench Method follow.

- o Strip and separately stockpile the topsoil for future landscaping and reclamation.
- o Excavate a trench to contain the waste. This will usually be large enough to contain wastes for one year.
- o The depth of the trench excavation depends on the volume of expected wastes planned per cell and the depth to the groundwater table.
- o To better control the placement of wastes, keep the trench width narrow, but provide sufficient width for tracked equipment to work when compacting and covering the wastes. This is usually a minimum of 5 m.

FIGURE 7.1
THE TRENCH METHOD



- o Stockpile the excavated soil at the sides or end of the trench to allow easy placement of this material over the wastes.
- o Orient the long dimension of the trench perpendicular to the prevailing wind.
- o Provide access to the trench at one end for tracked vehicles.
- o Provide on-site drainage to stop surface water from entering the trench. Ideally, the only water entering the trench should be precipitation falling directly on it.
- o If possible, grade the trench to allow water within it to move away from the wastes. Then dispose of wastes sequentially from the high end to the low end. This allows water to flow away from the waste and be removed.

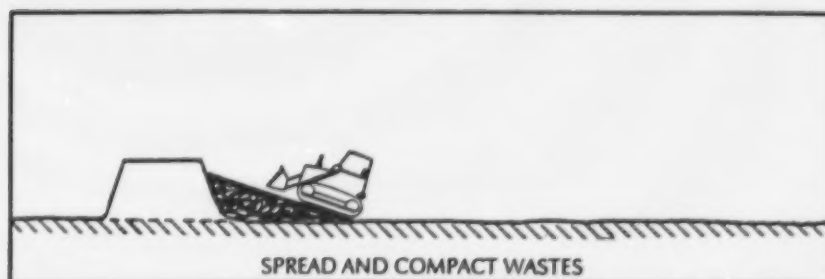
Area Method

The Area Method can be used on flat or sloping ground where soils are unsuitable for excavation or a high groundwater condition exists. In this method, wastes are regularly compacted and covered but are deposited directly on the native ground (Figure 7.2). This method can make use of flat ground, slopes, or depressions, but is sometimes more difficult and expensive than the Trench Method. Though trench excavation costs are eliminated, soil cover material must be obtained from other on or off site areas. On flat areas, an enclosing berm should be constructed to start the placement of wastes and enclose the extremities of the waste cells.

Some general guidelines in the operation of the Area Method include:

- o Strip and separately stockpile the topsoil for future landscaping and reclamation.
- o Locate a suitable cover source on the site or import the soil if necessary.
- o Fence or berm the dumping area to control the size of the site and define the waste boundaries.

FIGURE 7.2
THE AREA METHOD



- o Provide on-site drainage controls to channel precipitation and runoff away from the wastes.
- o Place litter catching devices and align the berms and cells to reduce blowing wastes.

At many sites, a combination of the trench and area methods may be possible. In this method (Figure 7.3) soil for berm construction and waste covering is excavated from the disposal site allowing for a greater waste depth and a reduction in the area required for the landfill.

7.3 DISPOSAL AREA ESTIMATION

The area required to construct and operate a landfill disposal site is influenced by a number of factors. Some of these factors include the present and predicted user population, the amount of wastes they generate, the degree of compaction, the depth to which trenches can be excavated, the height above ground to which wastes can be placed, and the number of years the site is to be used. With so many factors to consider, the area required for landfill development must be determined on a case by case basis. Figure 7.4, however, provides a general guideline for relating landfill space requirements to population size at various levels of compaction. A community of 1000 people, for example, could contain all their wastes safely for a 20 year period in less than 5 acres (2 ha).

7.4 LANDFILL DESIGN ELEMENTS

The following sections discuss many of the features that may be included in a well planned landfill site. Figure 7.5 shows several of these features and indicates how the same landfill site can be designed for either the trench or area method of waste disposal.

FIGURE 7.3
COMBINATION TRENCH AND AREA METHOD

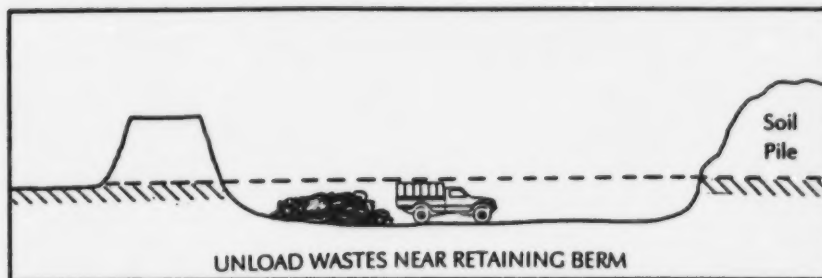
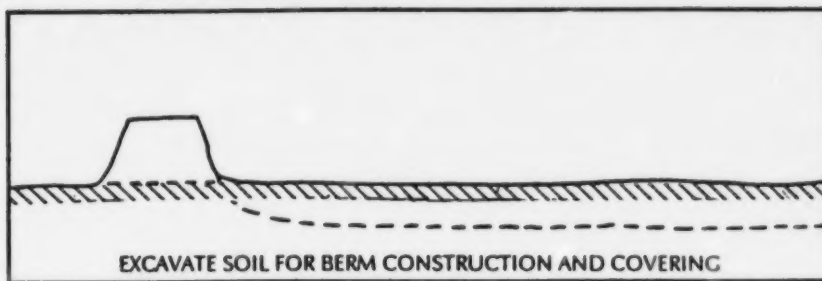


FIGURE 7.4
AREA REQUIRED FOR WASTE DISPOSAL SITE

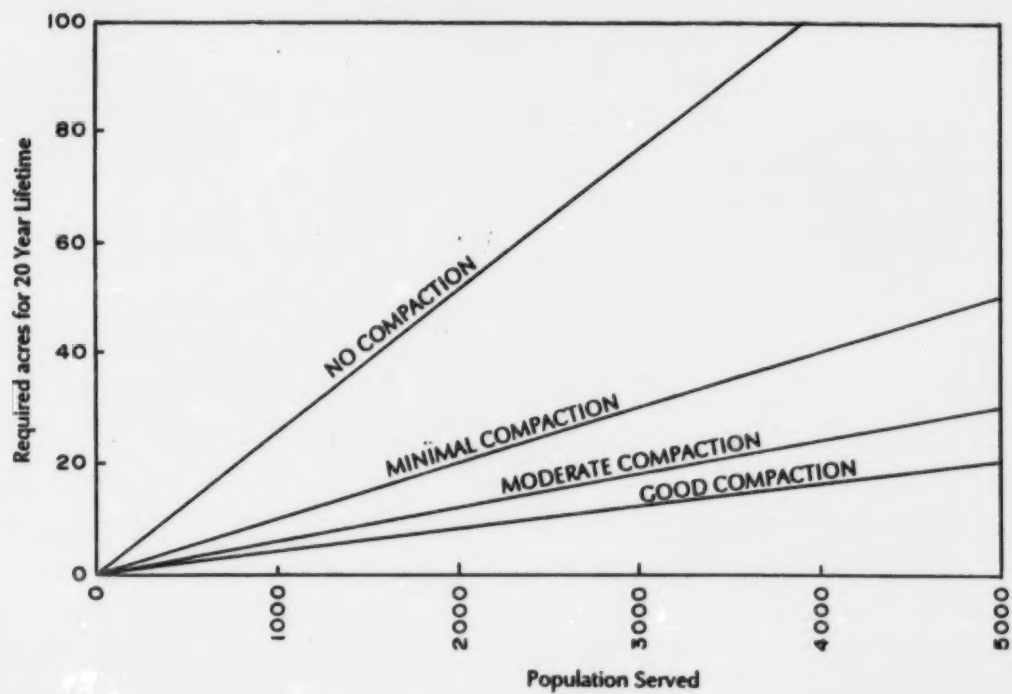
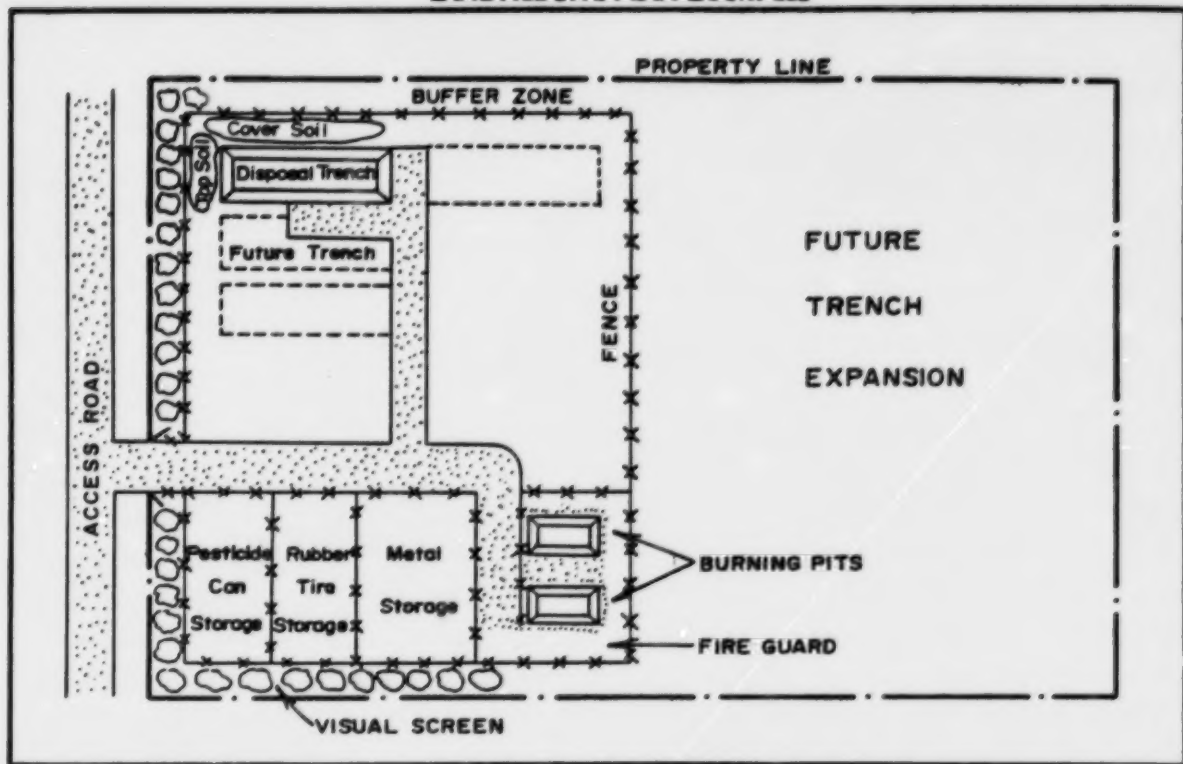
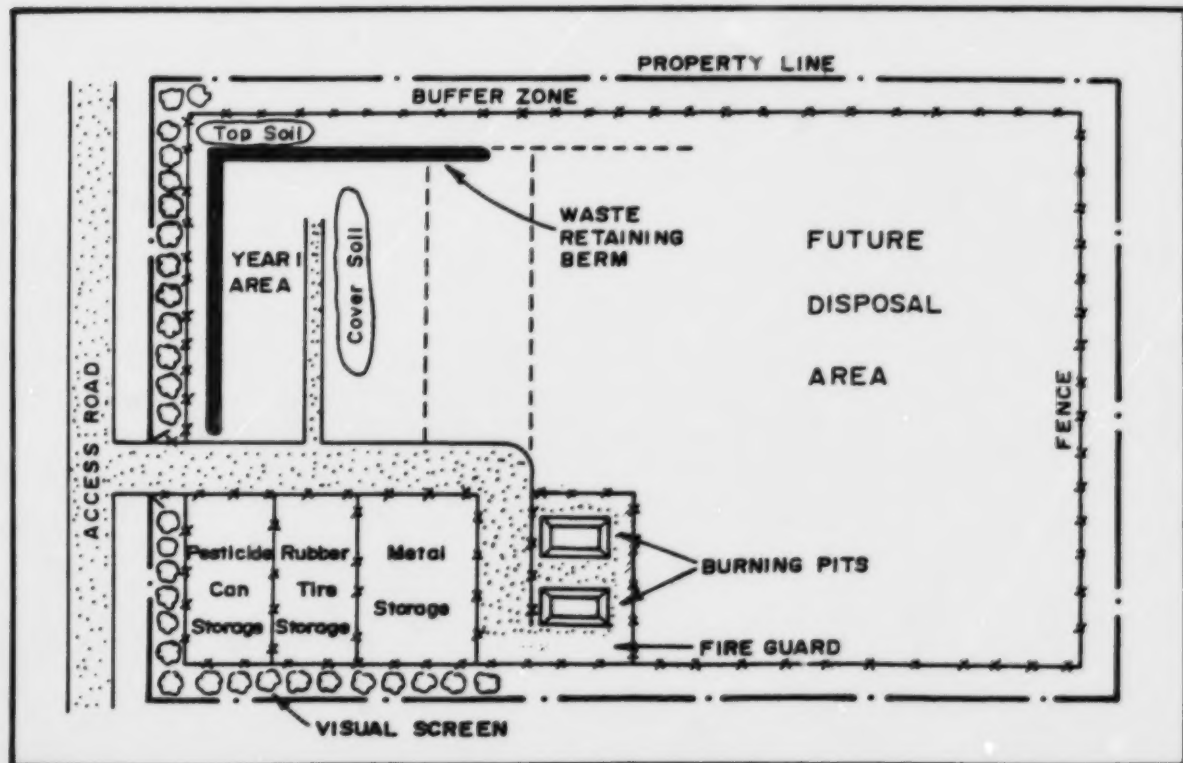


FIGURE 7.5
LANDFILL SITE PLAN EXAMPLES



TRENCH DISPOSAL METHOD



AREA DISPOSAL METHOD

Access Roads

Well drained, properly surfaced, all-weather access roads are important for the site. They must be provided from the municipal road to the current disposal site and be able to accommodate the expected volume of traffic. For small disposal sites, these roads should be at least 5 m wide, and at least 6-8 m wide for larger sites. Access roads should be kept free of litter and mud and be fenced from the municipal road to the landfill site.

On-site roads are generally constructed of on-site material and surfaced with gravel. The road base could be constructed of crushed stone, cinders, broken concrete, asphalt, mortar, bricks, lime, or demolition wastes. Right-of-way allowance will depend on the size of the operation. Grades should be kept to a minimum and adequate turn-around areas should be provided.

If temporary roads are built over previously filled areas, maintenance of the grade will be increased as settlement of the wastes below the road occurs. In some cases, a layer of pitrun beneath the road surface will be required to stabilize the road grade.

Fencing

Fencing can perform several tasks at a landfill site and is used especially to restrict human access, to keep large animals out, and to contain blowing litter. To accomplish these tasks, a page wire or watchman fence is recommended. Chain link can be used but it is normally much more expensive than watchman type fences with driven T-bar posts. At smaller sites, portable fences can be placed around only the active disposal area and moved as required to save costs. Or, discarded 45 gallon drums can be used to define the disposal areas and control traffic movements. In this case, it would be good practice to fence the entire waste disposal area with barbed wire. Wooden fences are not recommended as they may be potentially damaged by fire. Snow-fencing, however, is recommended in winter to control the buildup of snow. Portable litter fences can also be used down wind of the dumping area to catch loose material but these must be cleaned periodically.

The main purpose of the fence is to control and define access. Unauthorized access can lead to indiscriminate dumping. To promote proper use of the site, it should be

kept as clean and attractive looking as possible. Better fencing around the working area will provide litter control, though the fence should be regularly cleaned to improve aesthetics and to stop it from being plugged up and blown over.

Gates and Signs

Many landfill problems, such as indiscriminate dumping and scavenging, can be best avoided by controlling access to the site. While not always necessary at small landfill sites, it becomes more necessary at larger sites to ensure an efficient operation. If supervised, the site will be opened by the operator. If not, some other system will be required to gain access, such as obtaining a key at the Town Office. An attractively designed and landscaped entrance with trees and grass will improve the aesthetics of the site and often the public's perception of it.

It is important that good quality, clearly written signs be provided at the entrance. They should show the hours of operation or how access to the site may be gained, the materials acceptable for delivery, and where they should be deposited. Other on-site signs should also be used to identify special storage areas and to provide direction to the main landfill.

Screening and Buffer Zones

Screening can serve a number of purposes at a waste disposal site. By planting trees and shrubs along the site's perimeter or leaving the existing tree cover around the site the aesthetics can be improved by providing a visual block of the area. These trees and shrubs also act as a windbreak and as an additional trap for blowing litter to safeguard adjacent property.

Some operators believe that unsupervised sites should not be screened as this openness allows persons abusing the site to be observed from nearby roads and dwellings. This chance of observation provides the incentive to properly use the site. The decision in this approach, however, should be left to the operating municipality.

An open buffer zone between the property line and the waste disposal areas provides an undisturbed space for observation wells and groundwater monitoring, a temporary storage area for cover and topsoil, and space to ensure that all waste disposal areas

receive a reasonable final grade to the property line before final landscaping. In addition, buffer zones can provide an adequate fire break in treed or bushy areas.

Drainage Facilities and Erosion Control

One major source of pollution at waste disposal sites occurs when water mixes over long periods with solid wastes and then enters either the surface or groundwater systems. A waste disposal site, therefore, must provide for the diversion of a large portion of surface runoff and snow-melt from the waste disposal area, especially from the working face. Total diversion is normally impossible, but design and operational procedures should try to maximize the amount diverted. Open channels capable of handling most runoff conditions without overflowing should be considered. Channels near the disposal areas should incorporate culverts or lined trenches.

To ensure proper runoff from the final covered landfill surface, grades of at least 2% should be maintained. Grading of the side slopes can vary depending on soil characteristics, vegetation and rainfall quantities, but generally should not exceed 3:1 to prevent excessive erosion and to maintain slope stability.

A landfill surface where no burning has occurred may subside by 5-20% as settlement in the wastes occurs. A final covering for the waste of 500 to 800 mm should be provided to minimize the cracks and depressions that enable water to infiltrate to the wastes below. Planned periodic maintenance of the final surface should be carried out as part of ongoing operations to fill cracks and depressions and prevent the ponding and infiltration of water. Leachate control at landfill sites is not normally required if proper drainage and infiltration control is provided.

Litter Control

Litter, though not a serious environmental problem, is a major factor in how the public perceives a landfill site. Several steps can be taken to reduce this problem, however, such as aligning trenches or waste control berms perpendicular to the wind and placing tree rows or snow fences upwind of the disposal area. Snow-fencing or plastic fences can also be placed down wind of the disposal site to catch the litter though these fences will have to be cleaned frequently to keep them from becoming clogged.

Burning of Wastes

In Saskatchewan, refuse can only be burnt at a landfill site if specific approval is given in the waste disposal permit. The typical wastes burnt include trees, lumber, paper, rubbish and yard clippings. While burning can reduce the volume of these wastes by 50-80%, reduce wind-blown material, and render the wastes less accessible to birds and animals, not all wastes are combustible. Wastes such as animal carcasses and manure, pathological wastes, non-wooden construction and demolition wastes, railway ties, automobile bodies, rubber and plastic products, used oils, and residential, commercial, and industrial garbage should not be burnt.

If waste burning is permitted as a periodic disposal option, the wastes should be segregated and deposited in a separate trench and only burnt when the wind is favorable. They should never be burnt with the other deposited wastes in the landfill site. Burning periods should be supervised and access to fire fighting equipment should be readily available. Ashes should not be placed in the landfill until they are thoroughly cooled and they should not be moved on windy days.

Buildings and Utilities

Equipment, if it is to be stored on the site, should have a shelter. This shelter does not have to be heated, but should be secure from the public.

The level of utilities provided depends on the level of supervision provided at the site. For supervised sites, sanitary toilets and drinking water should be available for the staff, and larger sites could consider power and telephone. In case of a fire or accident, a telephone or radio is important for communication, and reasonable access to a water supply such as a tanker truck would help with fire suppression.

Special Waste Facilities

Some solid wastes require special storage and handling procedures. In general, disposal of paints, process sludge, used oil, old batteries, pesticide containers, dead animals, and powdery or low density wastes can pose human or environmental hazards and are not permitted for disposal. If disposal of these wastes has been

specially permitted by SEPS, special storage compounds will be required as co-disposal of these items with other landfill wastes can result in groundwater pollution problems.

Similarly, large, bulky items, such as used automobiles, appliances and tires should be stored in separate compounds. Co-disposal of these items with regular landfill wastes is a poor management practice in terms of space efficiency and waste handling as they are difficult to crush, move and work in with the regular wastes.

All of the above wastes are best disposed of away from the main refuse stream and stored in special storage compounds. Automobiles, appliances and tires can be stored for later recycling if markets exist, or for later crushing, shredding and disposal. Many disposal sites also designate specific areas for metal or aluminum cans or for glass bottles. If pesticide containers or other normally unpermitted wastes are allowed to be disposed of at a landfill site, they must be segregated and properly stored in carefully designed compounds. Many runoff and potential pollution problems can be avoided by covering the compound with a simple farm type structure to shed precipitation. All special storage areas should be fenced or bermed to delineate them and posted to specify their use.

Site Monitoring

Even the most carefully designed and constructed landfill must be monitored for environmental effects. To ensure groundwater protection, monitoring wells should be set up to observe water movement away from the site. At larger sites, monitoring wells may have been established during initial site evaluation which can then be used for later monitoring. The buffer zone around the site provides a good, undisturbed area for well placement to monitor groundwater within the disposal site boundaries. Initial baseline water quality data is required to determine whether landfill activities are having any influence.

Methane gas production will occur at some stage in any waste disposal site. Generated from decomposing wastes, the gas can be dangerous in concentrations as small as 5 percent. Its ability to escape into the atmosphere depends on the type of soil used to cover the wastes. Fine textured soils that are excellent at controlling infiltration also impede the release of gas and can result in concentrations of the gas in the soil. If upward gas migration is not possible, methane can also migrate away

from the site and come to the surface at some distant point. This is sometimes made evident from sickly or dying vegetation in the buffer zone. Though this will likely not be a problem at small landfill sites due to the low volumes of gas generated. Simple gas venting systems may have to be installed in the completed landfill cover to allow the gas to escape.

SECTION 8.0

LANDFILL OPERATION

The proper operation of a waste disposal site is perhaps the most important aspect of a successful facility. Unless a site is properly operated, the best possible design is of little value. The perceptions of both the public and the regulatory agencies will be formed from their observations of the site operation. The operational plan, whether formal or informal, should be developed during the site's design stage.

8.1**CELL DESIGN AND COVER REQUIREMENTS**

The cell is the basic building block in both the trench and area disposal methods and is formed when deposited wastes are spread, compacted and covered with soil. One layer of many such cells is called a lift, and one or more lifts make up a completed disposal trench or area. Spreading, compacting and covering the wastes is required by the Saskatchewan Municipal Refuse Management Regulations and is undertaken to achieve the following benefits in the solid waste disposal process.

Aesthetic

- controls blowing paper and trash
- controls odours
- provides a base for vegetation growth and a more desirable appearance

Health

- minimizes vector breeding and maximizes insect control
- controls water infiltration
- limits gas migration
- minimizes the potential fire hazard

Land Management

- aids compaction
- preserves slope stability of the wastes
- supports a vegetative cover
- minimizes erosion
- controls water infiltration and movement
- acts as a base for roads and site traffic

Spreading and compacting the wastes greatly reduces the volume required to dispose of them. As shown previously in Figures 5.1 and 5.2, the density of compacted wastes varies with the thickness of the layers the wastes are spread into and with the number of passes made over them by the equipment. Good compactness can be achieved when waste layers are kept to a maximum of 600 mm and passed over three to five times.

Wastes in a modified landfill must be covered with soil as often as required in the *Permit to Operate a Waste Disposal Ground*. A minimum 150 mm of soil, called **primary cover**, should be periodically placed on the wastes to form a cell. If some time will elapse before another lift will be added on top of this cell, a 250-300 mm **interim cover** should be placed over the waste instead. When the final lift has been added the **final cover** should be placed. This final cover should range between 500 and 800 mm and bring the disposal area to its final grade. Approximately 150 mm of this cover should be a suitable topsoil to enable the surface to be re-vegetated.

The amount of soil required as cover largely depends on the area of the working face. Cell dimensions, therefore, play a significant role. As a general rule, cells should be rectangular, with the open face sloping as steeply as practical so that the surface area of exposed wastes can be kept to a minimum. Slopes of 15 to 25% will do this while still enabling good waste compaction to take place. The greater the slope, the less surface area to cover with soil, but the less the vertical compaction pressure that can be exerted by the machine.

Cell heights can be quite variable though some operators feel that a 2 metre maximum will minimize settlement. Large landfills, however, often have cell heights of 10 or more metres. Specific cell dimensions will be determined by the amount of waste deposited, its level of compaction, and the frequency of covering.

8.2 LANDFILL EQUIPMENT

Landfill equipment is used to excavate soil, to spread and compact the wastes, to cover the refuse layers, and to construct and maintain on-site roads. The equipment must be reliable and should be of the most practical size necessary to complete its tasks over the projected landfill life.

The quantity and type of waste to be handled are among the most important factors to consider when choosing waste disposal equipment. The right machine must be able to compact and cover all the wastes that will be generated between work periods. In addition, the type of wastes will influence the choice of machine. Heavy construction wastes, for example, may require a larger tracked type machine to move them around. Some of the factors to consider when selecting a machine for landfilling operations include:

- o Amount, type and distance of soil to be moved.
- o Time required for compaction and covering.
- o Site requirements to clear bush or trees.
- o Specific site condition such as topography and ease of excavation.
- o Any auxiliary tasks such as road and drainage system maintenance, vehicle unloading, or moving materials around the site, among others.
- o Maintenance needs.
- o Increasing waste quantity and demands over the site life.
- o Changes in weather.
- o Local availability of parts and maintenance.
- o Purchase and operating costs.
- o Operator comfort.
- o Landfill method utilized.
- o Compaction requirements.

In general, equipment needs relate to time and site constraints and the ability to effectively undertake certain jobs. Equipment should never be undersized, yet being too large can make work difficult in small spaces and not be cost effective. Landfill operations are extremely hard on equipment, especially regarding undercarriage repairs and cooling problems caused by paper and debris entering the motor housing. Equipment reliability depends on its careful use and maintenance so good maintenance records should be kept if municipal owned equipment is used. At smaller sites, the equipment used for landfilling will probably be determined by what is locally available. At larger sites, backup, or standby, equipment may have to be arranged in case of prolonged breakdowns.

For small communities, tracked typed loader equipment is probably the best as it is able to handle a variety of tasks such as road maintenance and construction, soil

moving and waste spreading. If equipped with a ripper attachment, its usefulness in frost and consolidated soil conditions is increased. Because they are more limited in moving soil and large objects, straight pusher type tractors are not as versatile as tracked type loaders equipped with a bucket. Backhoes and draglines are much less versatile and are best considered only for excavation work. A summary of the advantages and disadvantages associated with the various equipment types is found in Table 8.1.

8.3

GENERAL OPERATIONAL GUIDELINES

Waste Collection

- o Collection of municipal solid wastes, if provided, is recommended on a weekly basis as this frequency enables the maintenance of acceptable sanitary and aesthetic conditions within a community.
- o Collection of bulky wastes, such as tree prunings, is needed much less frequently and can be arranged within the community on an annual or semi-annual basis.
- o The type of waste collection vehicle and the crew required will depend on the size of population served by the landfill. Typical collection vehicles for small communities range from half-ton trucks to self-contained compactor type trucks. The larger the vehicle's capacity, the fewer the trips to the landfill, and the less fuel, labour costs, and travelling time required. These factors may be offset against the increased cost for larger equipment and against the non-productive periods for the collection vehicle.
- o The number of crew can vary from one operator in small communities, to one operator and one or two helpers in larger ones.

Unloading Wastes

- o Wastes should only be unloaded in a small, controlled working area.
- o Fencing can be used to control the size and location of the dumping area.
- o Wheel stops can be set up to mark the dump area and ensure that no vehicles fall into trenches.

TABLE 8.1
Equipment Advantages and Disadvantages

EQUIPMENT	ADVANTAGES	DISADVANTAGES
TRACK TYPE TRACTOR 	Excellent for spreading waste and cover material, and for excavating soil. Works well on steep slopes and in wet conditions. Can move earth up to 100 m (or more if a scraper is attached). Great versatility. Ripper attachment can help excavate frozen soil in the winter. Useful to prepare and construct the site.	Clogging of refuse in tracks which can lead to higher maintenance costs. Has difficulty compacting bulky items.
TRACK TYPE LOADER 	Able to lift and carry soil. Excellent for spreading waste and cover material, and for excavating soil. Works well on steep slopes and in wet conditions. Loader leaves soil stockpiles in a loose state to ease winter excavation. Great versatility. Useful to prepare and construct the site.	Clogging of refuse in tracks which can lead to higher maintenance costs. Has difficulty compacting bulky items. Not able to pull scrapers.
RUBBER TIRE LOADER 	Great mobility combined with speed. Good waste spreading ability. Good compaction ability. Versatile - if a variety of front-end attachments are available.	Traction is poor if conditions are poor. Ability to excavate limited to light soils. Works poorly on steep slopes. Unable to compact bulky items. Tires are susceptible to punctures so should be urethane foam filled.
RUBBER TIRE SCRAPER 	Designed to haul soil longer distances. Good excavating capability. Excellent spreading ability.	Versatility limited to one purpose. Compacts soil when dumping so is poor for stockpiling. Landfill use limited to excavation and final covering.
BACKHOE 	Excellent for excavating most soils. Stockpile soil in a loose state for easier cold weather use.	Are slow for large excavations. Have a limited reach Designed for only one purpose.

Waste Separation

- o Recyclable wastes, or those requiring special handling, should be placed in separate areas.
- o Clear signs and directions are required to define the storage, disposal and burning areas, and the types of wastes to be deposited in each.
- o Site supervision may be required to effectively control waste separation.
- o At landfills where trenches are not used, wastes can be blended to increase their handling efficiency. Wet wastes, for example, can be combined with dry to provide an easier waste to handle.

Burning

- o **During burning, the site must be supervised.**
- o Burning should only be considered when the operational permit allows.
- o It should be done in a separate burning trench, not along with the wastes in other areas.
- o Only "burnable" debris, such as straw, grass, leaves, tree prunings, brush, power poles and wooden construction and demolition materials should be burned.
- o "Prohibited" debris, such as animal carcasses and manure, pathological wastes, non-wooden construction and demolition wastes, railway ties, automobile bodies, rubber and plastic products, used oils, and residential, commercial, and industrial garbage should not be burned.
- o Burning of paper should be avoided unless a screen is placed over the burning trench to intercept ashes and airborne burning paper.
- o Supervision may be required to ensure that only "burnable" material is placed in burning trenches. Other material may have to be removed.
- o Two burning pits are ideal as waste can accumulate in one while burning is taking place at the other.

Fire Control

- o Fires within the waste are best controlled by digging out the burning material and mixing it with dirt to extinguish. No wastes should be placed back in the landfill until the fire is completely extinguished.

- o A fire extinguisher should be available on each piece of equipment to control small fires.
- o A water wagon, or some sort of fire control equipment should be available upon call in a reasonable time.
- o Burning wastes arriving on site should be deposited on the surface in a separate area away from the regular wastes and extinguished.

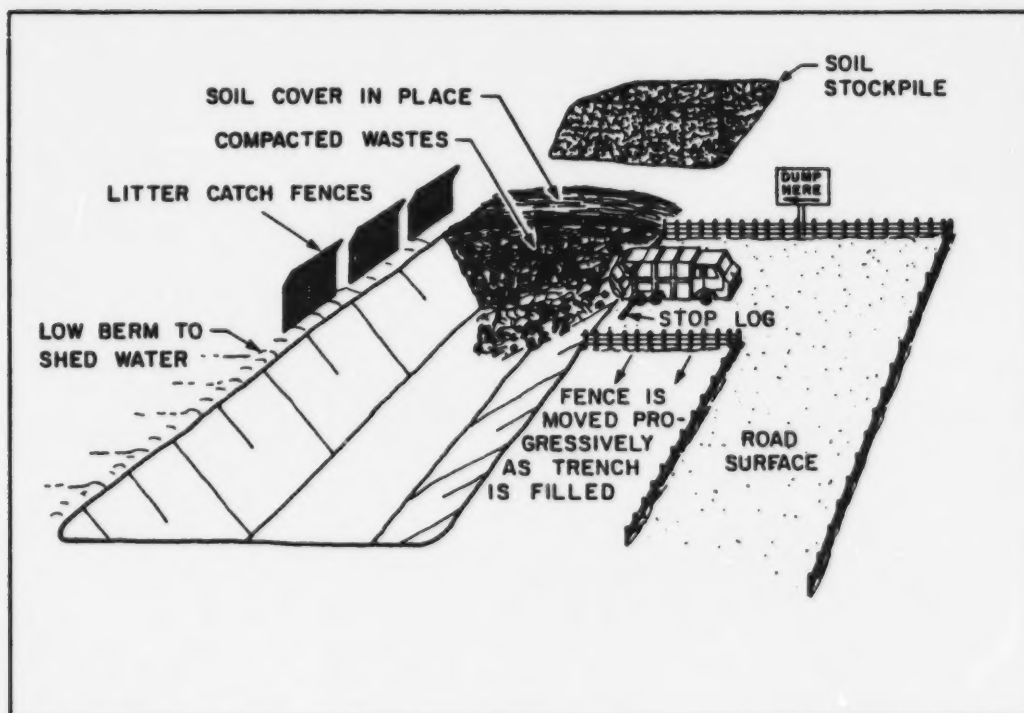
Recyclable Storage

- o Storage areas should be defined by fences and maintained in a clean and orderly manner.
- o Pesticide cans should be stored in a separate, secure compound.
- o When storage areas are filled, arrangements should be made to remove the material for recycling or other final use.

Working Face Practices

- o Wastes can be deposited at either the top or bottom of the working face.
- o Wastes deposited at the bottom will not be as susceptible to blowing.
- o Ideally, wastes should always be spread and compacted up the working face.
- o If wastes are deposited at the top of the face, they should be spread down and then pushed back up, compacting them in layers.
- o Slopes of 15 to 25% will allow good waste compaction while minimizing the exposure of the working face and the soil required for covering.
- o The waste disposal area should be sloped to allow precipitation to drain away from the waste and pumped out if required.
- o Wastes should be placed sequentially within the disposal area from higher grades to lower.
- o If disposing in trenches, equipment access should be provided at the bottom end of the trench.
- o Several of the above working face practices are shown in Figure 8.1.

FIGURE 8.1
DISPOSAL TRENCH CONTROL



Source: Alberta Environment

Waste Compaction

- o Can greatly increase the life of the site and minimize the cost of reclamation. Conversely, it requires more equipment time and more frequent equipment availability on site.
- o Saskatchewan Municipal Refuse Management Regulations require that the waste be spread in layers and compacted on a regular basis. Frequency of compaction will be specified in the Operational Permit.
- o Generally, 3 to 5 passes over the waste layer will achieve good compaction. Compaction density is greatly increased if the layers are 600 mm or less in thickness. This can be hard to accomplish with periodic equipment usage.
- o Waste compaction in trenches is harder to achieve with periodic equipment usage.

Periodic Waste Covering

- o Once wastes are compacted, they should be covered with 150 mm of compacted soil as a primary covering.
- o The soil covering should be extracted from the adjacent soil stockpiles or imported.
- o The frequency of waste compaction and covering can vary with the size of the user population. Table 8.2 provides some general guidelines for this frequency based on user population.

TABLE 8.2
Frequency of Compaction and Covering

USER POPULATION	DAILY WASTE VOLUMES* (KG)	FREQUENCY OF COMPACTION AND COVERING
1000	1500	12 x per year
2000	3000	2 x per month
3000	4500	3 x per month
4000	6000	1 x per week
5000	7500	1 x per week

* Based on a generation rate of 1.5 kg/person/day.

Litter Control

- o Is one of the key elements affecting the landfill sites public image.
- o Litter within the site, along roadways leading to the site, and on neighboring property should be picked up regularly.
- o Portable catch and wind fences can be placed near the disposal area, but these must be maintained. Litter fences should be kept free of debris to stop them from being blown over.
- o Windbreaks or snow-fencing can help control windblown litter.
- o The wind is less able to pick up wastes when they are dumped at the bottom of the working face.
- o If trenches are used, it is often recommended to place them at right angles to the wind.
- o Wastes should be covered while in transport on a vehicle.

- o Wastes that are bagged prior to collection and disposal can greatly reduce the litter problem.
- o Dumping should be controlled within as small an area as possible.

Site Maintenance

- o Wastes that have not been properly placed should be pushed into the disposal trench or working face.
- o Roads should be kept smooth and free of snow and debris.
- o Drainage systems and culverts should be cleaned of debris and kept in a free-flowing condition.
- o Fences should be kept clean and in good repair.
- o Direction signs should be repaired and repainted as needed.
- o The use of oil drums for traffic control is effective.

Dust Control

- o Dust control can be achieved by periodically spraying the road down with water or mixing calcium chloride in with the gravel.
- o Good road maintenance improves dust control.

Surface Water Control

- o Surface drainage should be diverted away from the wastes and trenches.
- o If expected runoff volumes are high, erosion can be reduced by lining drainage ditches with boulders, broken asphalt or concrete, or half pipes of corrugated metal or concrete.
- o Side slopes on covered waste should be graded and planted to grass to avoid erosion.
- o The top covering on the wastes should be graded to at least 2% to provide positive surface drainage.
- o Precipitation entering the trenches should be collected and removed as soon as possible to reduce contact with the wastes.

Hours of Operation

- o The hours of operation should be set to provide maximum convenience to users.
- o The site should be closed at night to prevent indiscriminate dumping.
- o If the site is supervised, the hours of operation will depend on the budget. They can generally be reduced providing the community is kept well informed.
- o The hours of operation should be posted at the entrance.
- o When the site is new, the hours of operation should be advertised in local papers to make the public aware.

Supervision

- o A supervisor may or may not be continuously required at the site depending on whether:
 - the waste volume and the landfill size warrants it
 - continuous operational difficulties occur
 - users have been educated and will follow posted rules
 - the burning of waste occurs.
- o A supervisor's duties should include:
 - site maintenance
 - ensuring wastes are deposited in the proper place
 - controlling the types of wastes deposited
 - supervising burning, if it is permitted
 - ensuring that no unauthorized burning occurs
 - preventing unauthorized scavenging
 - periodically spreading, compacting and covering the wastes or arranging for it to be done as permitted.

Final Covering

- o When a disposal area is completed, it should receive 500 to 800 mm of compacted soil as a final cover.
- o 150 mm of this final cover should be topsoil to allow re-vegetation and landscaping.

- o The cover should be graded to a minimum 2% slope to shed water.
- o After settlement has occurred in the wastes, the voids and depressions should be filled to eliminate water infiltration problems.

Bad Weather Planning

- o Closed cabs on equipment and proper clothing should be provided to the workers.
- o High silt and clay soils become very muddy with rain. During extreme wet weather, an alternate disposal area should be available.
- o Provision should be made to reduce mud being tracked onto public roads. Texas gates can be useful in this.
- o Equipment should be stored indoors or plugged in to enable cold weather starting.
- o Planning for cover during winter months should be undertaken. Soil should be stored in loose piles to reduce the work required to spread it, or a less troublesome winter cover material such as sand or gravel could be used.

Accidents

- o Potential accidents include:
 - injury from explosion or fire from materials in the waste
 - inhalation of contaminants or dust
 - falls from vehicles
 - traffic accidents on site
 - heavy equipment accidents
 - exposure to extreme heat or cold.
- o Safety procedures should be established with all staff.

Record Keeping

If a site is supervised, records can be kept on its use. Good site records can be useful in a number of ways.

- o Weigh scale data provides the best information on the wastes deposited. If weigh scales are not used, vehicle counts on a regular or periodic basis and an

estimation of their waste loads can provide reasonable data. This information helps to better determine the remaining site life.

- o Operation and maintenance statistics should be kept for municipally owned equipment.
- o Costs associated with the landfill can be compared to budgets.
- o Labour and material records can be tracked.

Environmental Monitoring

Methane gas production and groundwater contamination are two environmental concerns of landfilling.

- o Methane gas production occurs at every landfill, though it should not be a problem at small community landfills.
- o Poor quality or dying vegetation in the buffer zone could be a sign of methane gas buildup in the soil. If determined to be a problem, inexpensive vents can be installed in the landfill cover to enable the gas to be released.
- o Water monitoring wells can be established to track any changes in groundwater quality attributed to the waste disposal site. Wells drilled during the site investigation stage can be used, or new ones can be drilled in the buffer zone.
- o Baseline water quality information should be obtained before wastes are deposited in the landfill.
- o Water should be sampled and stored in clean bottles. These bottles and instructions on the sampling procedures can be obtained from the testing lab.
- o Water samples should be sent in immediately after testing and should not be allowed to freeze.
- o Simple water quality analysis includes testing for nitrates, chlorides, conductivity, pH and iron. While these tests may indicate some relative changes due to landfill development, they do not measure for pollutants.

- o Testing for pollutants such as pesticides moving away from the site can be quite costly. The easiest way to test for them is to maintain an accurate record of their occurrence in the landfill. A water quality lab will be able to test for a pollutant with much greater accuracy, if they know the brand names or main types of chemicals that were stored.
- o At most small community sites, testing for major pollutants such as pesticide residues can be made on a 5 year basis.

SECTION 9.0

FINANCING AND COST RECOVERY



LANDFILL COSTS AND BUDGETING

The financial aspects of operating a solid waste disposal site have not historically been taken to the same level as water and sewer rates. Costs for the operation of disposal facilities are not well recorded and, in the case of smaller communities, are not always even included in their budget estimates. Many of the costs involved in landfilling will be influenced by the specific conditions at the site. For example, land requirements, soil cover, and reclamation costs would be significantly different in a trench operation that allowed 2 metre deep trenches as compared to one that allowed a 5 metre deep trench. Waste disposal costs are also very sensitive to the economies of scale. Thus, the budget for a community of 100 persons might have a substantially higher per capita cost, for a lesser level of service, than a community of 2500 persons.

Solid waste disposal costs can be grouped into the following four components:

- o New site acquisition and development costs such as land purchases and permitting
- o Annual preparation costs
- o Annual operating costs
- o Close-out costs

After identifying each of these costs, a budget calculation sheet such as the one shown in Table 9.1 can be prepared and the total annual budget determined. Each of these four component costs are discussed in the following sections.

TABLE 9.1
Landfill Budget Preparation

	ANNUAL COSTS	ANNUAL PAYMENT COSTS*
Site Development Costs		
Site Preparation Costs		
Annual Operating Costs Labour Equipment Consumables		
Close-out Costs		

*These costs are to be pro-rated and an annual cost developed from column one data.

Site Development Costs

The costs relating to site development are usually incurred prior to any waste being delivered to the site. These include:

- o Land Acquisition
- o Permit Application Costs
- o Public Meetings (if required)
- o Access Road Development
- o Site Grading and Clearing
- o Fencing
- o Signs and Barricades
- o Storage and Shelter Requirements

The need to separately identify each of these costs usually occurs when land purchases or outside engineering costs are incurred. For very small communities, these costs are usually not significant and will generally not be identified separately.

Annual Preparation Costs

These costs relate to the preparation of trenches or area fill facilities to handle the upcoming year's wastes. In the case of trench operations, they consist of excavation costs to prepare a new trench, to place the excavated material into stockpiles, and to cover and compact the previous trench. In the case of area fills, the yearly preparation consists of berm construction and the stockpiling of cover material for future landfill needs.

Site excavation is usually undertaken by outside heavy equipment and thus the annual charge should be budgeted as equipment rental. Some contractors will give lump sum estimates which make budgeting easier. Others work on unit price contracts. These offer some advantages but require a preliminary and final survey to enable calculation of excavated quantities. When lump sum estimates are used, extra equipment time, if any, can be utilized for other site tasks such as cleaning, moving large objects to storage areas, road maintenance, and trench compaction.

Annual Operating Costs

These costs are those directly required to operate the landfill and are made up of labour costs for supervision, clean up, administration of annual work, and administration functions such as budgets, record keeping and billing. An annual budget should be prepared with estimates for each work component. It is normal to add 5 to 10 percent for overall administration of the budget items.

Annual equipment costs will be related to waste compaction, cover placement, site clean-up and maintenance, and access road maintenance. Equipment for these tasks is normally rented and the budget should contain a category for each work component. Because small communities will likely cover wastes periodically and use rented equipment, the extra expense necessary to achieve good waste compaction can be offset by the smaller parcel of land required to contain the waste, and by savings in other expense areas such as annual excavation costs, perimeter fencing of the site, and road construction and maintenance.

If the site has equipment storage facilities or a staff shelter, the cost of utilities and building maintenance should be included in the annual operating budget. In addition, a small account should be established for such consumables as gravel, such small equipment rentals as pumps, and small tool purchases. Larger sites should budget for periodic staff training in landfill operation or other beneficial courses.

Close-out Costs

Close-out costs are those required to secure the landfill site after landfiling activities are completed. The extent of the work required will depend on the extent of the work accomplished on an annual basis. Close-out activities include:

- o Removing access roads and fences.
- o Placing additional cover and grading the site to provide drainage.
- o Planting grasses and trees.
- o At larger sites, a small monitoring program to check for groundwater contamination and gas generation should be developed to provide data on the long term effects of the site. Close-out work should ensure that any wells used in the location or operation of the landfill remain useable for monitoring.
- o Monitoring costs may continue for a number of years after the landfill is closed and should be included in the budget.

9.2

COST RECOVERY METHODS

When the total annual costs to operate the landfill are known, a cost recovery method can be developed. The three basic methods to recover costs are through taxes, utility charges, or site disposal charges. These three methods are discussed below and their advantages and disadvantages summarized in Table 9.2.

TABLE 9.2
Advantages and Disadvantages of Cost Recovery Methods

	RECOVERY OF COSTS THROUGH		
	TAX RULES	UTILITY CHARGE	CHARGES AT LANDFILL
Single system to administer	yes	yes	no
Fair to all users	no	yes	yes
Fair to urban users but not to rural users	yes	yes	no
Fair to rural users but not to urban users	no	no	yes
Allows for full cost recovery	yes	yes	--
Will create abuse of system such as illegal dumping	no	no	yes
Requires site to be supervised when open	no	no	yes

Recovery Through Taxes

In cost recovery through taxes, the total annual cost, including provision for debenture or other forms of recovery on larger items, is added to the municipal budget and becomes part of the property tax assessment. This requires all costs to be brought to an annual basis, and any fiscal year end deficits or surpluses be adjusted on the following year's budget figures. Recovery through taxes is the easiest system to administer and allows all residents free access to the disposal site. Inequalities in the system can occur, however, when persons with low property taxes, such as a saw mill, place large amounts of wastes in the disposal site. Similarly, someone with high property taxes, such as a rendering plant, may be allowed to dispose of few wastes in the site because of the nature of the wastes they generate.

Recovery Through Utility Charges

Communities that have utility charges for such items as water, sewer and garbage pick-up can add an additional charge for waste disposal. This charge can be calculated for each class of customer and added on their utility bill. Recovery through utility charges can be a very fair method as the monthly or unit charges relate to the level of service provided. A further advantage is that the rates charged are structured

to recover all landfilling costs. If better service is requested, the rate can easily be adjusted to reflect the new level of service provided.

Recovery Through Site Disposal Charges

In this cost recovery option, a series of charges are established at the landfill based on either a volume or weight basis. A site supervisor collects a fee from each individual wanting to dispose of wastes at the site. The fees can be structured to fairly allocate costs depending on the level of effort required to handle and dispose of the wastes. This method, however, requires the site to be supervised and an accounting system to be in place which can substantially add to the annual operating costs.

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APPENDIX 1

APPLICATIONS AND PERMITS USED BY THE GOVERNMENT OF SASKATCHEWAN FOR WASTE DISPOSAL GROUNDS



Saskatchewan
Environment

Land
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Application for Approval to Establish a Waste Disposal Ground

File: _____

In accordance with Section 5 of the Municipal Refuse Management Regulations, I hereby apply for approval:

— please read instructions before completing this application.

A. General

Name of Applicant _____
(City, Town, Village, Rural Municipality, or Company Name)

Address _____

Postal Code _____ Telephone No. _____

Intended for Use by _____ Applicant _____ Joint Use (specify below)

Site Details:

Legal Description: LSD _____ SEC _____ TWP _____ RGE _____ W _____

Parcel _____ Certificate of Title No. _____

Present Owner of Land: _____ Applicant _____ Other (specify)

Are there existing zoning bylaws affecting this land?

_____ Yes _____ No

Does the proposed land use conform to the bylaw?

_____ Yes _____ No

Access to Site: _____ existing road

_____ undeveloped road allowance

_____ unsurveyed and undeveloped road allowance

Intended Use: _____ Municipal _____ Commercial

_____ Industrial _____ Transfer Station

_____ Other _____

Population to be Served _____

Approximate Size of Facility _____ acres/hectares

Present Site of Disposal: SEC _____ TWP _____ RGE _____ W _____

Do you intend to continue use? _____ Yes _____ No

Will closure be needed? _____ Yes _____ No

B. Site Assessment

Site Characteristics:

Is the site subject to flooding? _____ Yes _____ No

Topography: _____ flat _____ moderate slope _____ steep slope

Nature of Surface Soils: _____ Sand _____ Clay _____ Gravel _____ Other

Information describing surficial geology and ground water conditions is attached _____ Yes _____ No

Land Use:

Describe the present use of proposed site _____

Describe the land use of properties bordering the site.

North _____ South _____

East _____ West _____

Are any of the following located on or within 100 m of site?

Streets, roads, highways _____ Yes _____ No

Railway _____ Yes _____ No

Cemetery _____ Yes _____ No

(indicate on Land Use Plan)

Are any of the following located on or within 500 m of site?

Residence _____ Yes _____ No

Eating establishment _____ Yes _____ No

Hotel/Motel _____ Yes _____ No

Institutional facilities _____ Yes _____ No

Buried utilities (gas/oil) _____ Yes _____ No

Transmission lines _____ Yes _____ No

Buried Cable — telephone _____ Yes _____ No

— power _____ Yes _____ No

(indicate on-site features on Site Development Plan and off-site features on Land Use Plan)

Are any of the following located on or within 1000 m (1 km) of site?

Lakes _____ Yes _____ No Dugouts _____ Yes _____ No

River _____ Yes _____ No Irrigation Works _____ Yes _____ No

Streams _____ Yes _____ No Sloughs _____ Yes _____ No

Wells _____ Yes _____ No Reservoirs _____ Yes _____ No

Historic Sites _____ Yes _____ No Recreational Sites _____ Yes _____ No

Designated Wildlife Habitat _____ Yes _____ No

Archaeological Site _____ Yes _____ No

Ecological Reserve _____ Yes _____ No

(indicate on-site features on Site Development Plan and off-site features on Land Use Plan)

Are there any airports located within 8 km of site _____ Yes _____ No

Land Use Plan

Legal Description Of Site QTR/LSD _____ SEC _____ TWP _____ RGE _____ W _____

Note: Centre square (heavy border) represents a legal subdivision (40 acres)

Middle square (heavy border) represents area within approximately 500 m of site

Outer square (heavy border) represents area within approximately 1000 m of site

1. Sketch boundary of proposed site on centre square.
2. Indicate land use with the appropriate symbol.

Residence		Water Well	
Eating Establishment		Dugout	
Hotel/Motel		Slough	
Institutional Building		Irrigation Works	
Underground Pipeline		Reservoir	
Transmission Line		Historic Site	
Underground Cable		Designated Wildlife Habitat	
Lake		Archaeological Site	
River, Stream		Ecological Reserve	

C. Proposed Design

Describe and indicate the following on the Site Development Plan.

All-weather access road. _____

Perimeter fence material, installed length and height. _____

Drainage direction; existing or proposed drainage diversion works, their design and location. _____

Areas for special waste and waste types. _____

Proposed or existing structures and facilities. _____

Existing or proposed utilities. _____

Existing or proposed visual buffer. _____

Other improvements. _____

Existing or proposed stations for monitoring of air, land, and water. _____

I certify that the information contained in this application is true, complete and accurate.

Signature of Applicant

Date

Complete and submit to: Land Protection Branch
Saskatchewan Environment
Walter Scott Building
3085 Albert Street
Regina, Saskatchewan
S4S 0B1

(for information call 787-6488)

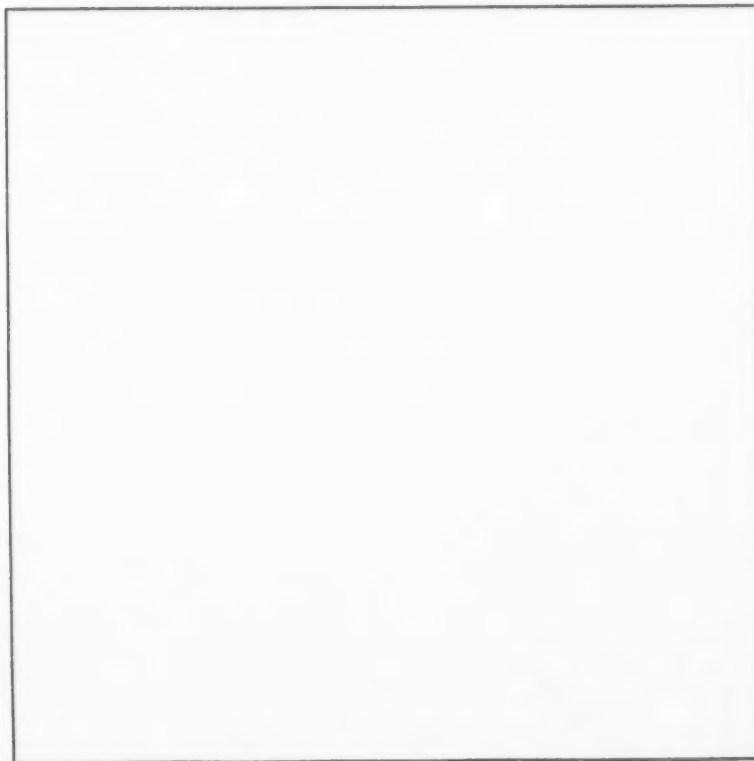
Site Development Plan

Legal Description of Site QTR/LSD _____ SEC _____ TWP _____ RGE _____ W _____

1. Draw boundaries of proposed waste disposal ground to an appropriate scale and indicate site dimensions.
2. Indicate any of the following features which may exist on-site or within 100 m of site boundaries with the appropriate symbol:

Highway	=====
Street, road	=====
Cemetery	C

3. Indicate any other features which may exist on-site or within 100 m of site boundaries which have been identified in Part B of the application.
4. Indicate features and improvements specified in Part C of the application.





Saskatchewan
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Branch

Certificate of Approval to Establish a Waste Disposal Ground

Page _____ of _____

File: _____

Issued pursuant to the Municipal Refuse Management Regulations,

_____ of _____, hereinafter called

the Applicant, is hereby authorized to establish a waste disposal ground on _____
in accordance with the following general conditions and special conditions:

General Conditions

1. This approval shall expire one year from the approval date.
2. This approval does not authorize operation of a waste disposal ground.
3. The Applicant shall advise Saskatchewan Environment of any change in design or location of the waste disposal ground from the plans upon which this approval is granted and obtain prior approval for any such change.
4. Upon completion of the waste disposal ground, Saskatchewan Environment shall be notified in order that the facility may be inspected prior to issuance of permit to operate.
5. If it is decided not to proceed with establishment of the waste disposal ground the Applicant shall advise Saskatchewan Environment to cancel this approval.
6. The Applicant accepts full responsibility for the design and establishment of the waste disposal ground.
7. This approval may be cancelled at any time by the Minister of the Environment if it is determined that the Conditions of Approval are not properly followed.

Special Conditions

Dated at Regina, Saskatchewan this _____ day of _____, 19 _____.

Minister of the Environment



Saskatchewan
Environment

Land
Protection
Branch

Application for Permit to Operate a Waste Disposal Ground

In accordance with Section 5 of the Municipal Refuse Management Regulations I hereby apply for a Permit to Operate a Waste Disposal Ground.

Name of Applicant _____
(City, Town, Village, Rural Municipality or Company Name)

Address _____

Postal Code _____ Telephone No. _____

Legal Description of Site:

LSD/QTR _____ SEC _____ TWP _____ RGE _____ W _____

Parcel _____ Certificate of Title No. _____

Proposed Operating Times:

_____ hours per day for _____ days per week.

Proposed Disposal Method:

_____ Trench _____ Mound _____ Other _____
(Specify)

Equipment Proposed for Operations:

The following features exist or have been established as previously approved by Saskatchewan Environment:

_____ All Weather Access Road	_____ Fire Guard
_____ Perimeter Fence	_____ Special Waste Area(s)
_____ Locking Gate	_____ Monitoring Stations
_____ Buildings	_____ Other _____
_____ Weigh Scale	_____
_____ Drainage Works	_____
_____ Visual Buffer	_____

I certify that the information contained in this application is true, complete and accurate.

Signature of Applicant

Date

Complete and submit to: Land Protection Branch
Saskatchewan Environment
3035 Albert Street
Regina, Saskatchewan
S4S 0B1

For information call 787-6488



Saskatchewan
Environment

Land
Protection
Branch

Permit to Operate a Waste Disposal Ground

Page 1 of

File:

Permit No. _____

Issued pursuant to the Municipal Refuse Management Regulations, _____ of _____, hereinafter called the Permittee, is hereby authorized to operate a waste disposal ground on _____ in accordance with the following general and special conditions:

General Conditions:

1. The waste disposal ground shall be operated in accordance with _____ landfill practices. Disposal of refuse shall conform to the following procedures _____ to be performed not less frequently than _____.
 - (a) Refuse shall be spread and compacted in layers.
 - (b) The layers of refuse shall be covered with a layer of earth material, approximately one quarter the depth of the refuse layer to form a cell.
 - (c) The cell shall be covered with 0.5 m of compacted earth material.
2. During periods when weather conditions preclude the construction of cells as described in (1) above, refuse may be accumulated until favourable conditions prevail, provided all other conditions of the operation are met.
3. All structural elements of the waste disposal ground, including but not necessarily limited to, fences, gates, roads, signs, barricades, drainage works and other parts, shall be periodically inspected and maintained to ensure their proper functioning.
4. The waste disposal ground shall be supervised at all times during operations. When the site is unsupervised, access shall be prevented by means of a locked gate.
5. A sign shall be erected at the entrance of the waste disposal ground which indicates the name, address, and telephone number of the operator, hours of operation, and waste types not authorized for disposal. Other items of information considered necessary by the Permittee may be indicated on the sign.
6. Waste types not authorized for disposal are:
 - (a) Automobiles or other large metal objects.
 - (b) Pesticides and other hazardous wastes, any material treated with their substances or the receptacles containing them.
 - (c) Petroleum, petroleum remains or by-products.
 - (d) Remains or by-products of slaughter house operations.
 - (e) Liquid domestic sewage.
7. No refuse shall be disposed of by burning at the waste disposal ground unless otherwise authorized in the Special Conditions of this permit.
8. Refuse shall be prevented from blowing away from the waste disposal ground by:
 - (a) Minimizing the size of the working face.
 - (b) Use of portable litter fences near the working face as necessary.
 - (c) Prompt covering of refuse.

Any refuse that has blown away or has otherwise left the site shall be retrieved.
9. The Permittee shall advise Saskatchewan Environment of intent to close the waste disposal ground before site capacity is exhausted and prior to cessation of operations.
10. This permit may be cancelled at any time by the Minister of the Environment if it is determined that the Conditions of Approval are not properly followed.

Special Conditions:

Dated at Regina, Saskatchewan, this _____ day of _____, 19____.

Minister of the Environment